Multivariable Calculus - MATH 223

Review Sheet for Exam 1

October 9, 2018

Let's breathe. Below is a list of relevant and important topics from the first two chapters. You are responsible for Sections 1.1 through **2.6**. If you can complete the homework then you should be able to do well on the exam. The below topics should help guide your study, and will guide my writing of the exam. The exam will be mostly computational, and to read most of the questions you will need to be familiar with the definitions listed. I have been known to ask for a definition statement, these are also essential to know in order to prove something.

Section 1.3 and 1.4

- Find the cross product and dot product of two vectors in $\mathbf{R}^2$ or $\mathbf{R}^3$

Section 1.5

- Find the equation of a plane: (a) given two points in the plane and a normal vector, (b) given three non-collinear points
- Given a plane, write the parametric equations for the plane
- Find the distance between a line and a point, two parallel planes, or a point and a plane

Section 1.6

- Know the statements of the Cauchy-Schwarz inequality and the triangle inequality

Section 1.7

- I WILL give you any of the change of coordinate formulas, you will need to know how to make a change of coordinates

Section 2.1

- Find and sketch the level curves of a two-variable scalar value function.

- Use the sketch of the level curves to describe (if you can't draw, like me) the surface

Section 2.2

- Compute a limit, or show why it fails to exist. May have to use a change of coordinates to help determine the limit.

Section 2.3

- Find the gradient of a function.
- Find the matrix of mixed partials.
- Know how Theorem 3.10 is useful.
- Find a "good" linear approximation of f near (a, b) and use it to estimate the value of the function at points near (a, b).

Section 2.4

- Know linearity of differentiation, the product rule, the quotient rule.
- Compute higher order partial derivatives, and mixed partials.

Section 2.5

- Be able to use the chain rule.

Section 2.6

- Be able to compute the directional derivative using Theorem 6.2
- Know when the directional derivative is maximized/minimized

Definitions to know:

- dot product
- cross product
- norm
- range, domain, codomain
- onto, one-to-one
- continuous
- open, closed, boundary, neighborhood, accumulation point
- limit

- differentiable at $\mathbf{a}$
- Class C^k, smooth
- directional derivative

Formulas to know:

- $proj_{\mathbf{a}}b = \frac{\mathbf{a}\cdot\mathbf{b}}{\mathbf{a}\cdot\mathbf{a}}\mathbf{a}$
- The angle between two non-zero vectors $\theta = \cos^{-1}\frac{\mathbf{a}\cdot\mathbf{b}}{||\mathbf{a}||\ ||\mathbf{b}||}$